

Nelson Biology VCE Units 1 & 2

Answers to Chapter Questions

Chapter 1

Review questions

- 1 Whole organism → systems → organs → tissues → cells
e.g.
rock wallaby → digestive system → small intestine → intestinal lining tissue (villi) → villi cells
- 2 As systems, organs and tissues are made of individual cells, they would all fail to function if cells were not functioning correctly.
- 3 1838 Matthias Schleiden – individual cells develop as an independent unit, nucleus involved.
1839 Theodore Schwann – plants and animals made of cells which have their own ‘life’.
Proposal of the cell theory
1849 First description of cell division
1859 Rudolf Virchow proposed all cells come from pre-existing cells.
- 4 The cell theory states that cells are of universal occurrence and are the basic units of an organism; furthermore, all cells come from pre-existing cells.
- 5
 - a The plasma membrane is present. Many ribosomes are present.
 - b Prokaryotic cells have a thick cell wall often covered by polysaccharides, but eukaryotic cells that have a cell wall are not covered by polysaccharides.
There are no membrane-bound organelles in prokaryotic cells, many membrane-bound organelles in eukaryotic cells.
Prokaryotic cells have a region of DNA that is not enclosed in a membrane and numerous small rings of DNA called plasmids. DNA in eukaryotic cells is located within the membrane-bound nucleus. No plasmids are present.
Flagella in prokaryotic cells are shaped like corkscrews; they rotate on their axes whereas flagella in eukaryotic cells propel the cell by a ‘waving’ motion. There is a different microtubule structure in the flagella.
- 6 Kingdoms Monera and Archaea contain organisms with prokaryotic cells. Organisms with eukaryotic cells belong to the kingdoms Plantae, Animalia, Protista and Fungi.
- 7 Because different cells vary in their functions, their size differs to allow them to perform their specific functions efficiently.
- 8 As a cell grows, its volume increases more than the surface area. As requirements enter and wastes leave through the surface, a point is reached where this cannot occur fast enough to allow the cell to grow any more yet still function efficiently.

- 9** **a** The plasma membrane (cell membrane)
 b Many substances enter and leave through the protein channels in the plasma membrane.
- 10** The cell wall provides extra support and protection to cells.
- 11** Cell walls are found in bacteria, plants, fungi and most algae. The cell walls in plants are made of cellulose, in fungi the cell walls are made of chitin and in bacteria they are made of proteins and polysaccharides. Algal cell walls vary in their composition.
- 12** Cytoplasm is found between the plasma membrane and the nuclear membrane.
- 13** Mitochondria are the organelles that allow cells to access energy. Cellular respiration takes place in these organelles (and the cytoplasm) and the energy released from this process is used to build ATP molecules. It is the ATP that stores the energy needed by a cell to carry out activities.
- 14** Human muscle cells use more energy when they perform their task of contraction and relaxation compared to the cells in your big toe. Therefore more mitochondria are needed to supply energy to build up more ATP molecules to be used for contraction of muscle cells.
- 15** Ribosomes build simple amino acids into proteins. Hormones are proteins, so cells producing them need a large supply of ribosomes. Even though skin cells produce proteins, the amount is less than in hormone-producing cells and therefore fewer ribosomes are needed.
- 16** The cytoskeleton
- 17** **a** Similarities: both can be readily assembled and disassembled.
 Differences: microtubules are hollow, microfilaments are solid.
 b Microtubules: provide a set of ‘rails’ for cell organelles to travel around the cytoplasm and in animal cells they are produced from the centriole to give rise to spindle fibres onto which chromosomes attach themselves during cell division.
 Microfilaments: when they contract, they can cause the cell to change shape.
- 18** Intracellular transport system: substances are able to move around the cell within the channels.
 Intercellular transport system: aids the movement of substances from one cell to another.
- 19** Smooth endoplasmic reticulum has no ribosomes attached to it, but rough endoplasmic reticulum is studded with ribosomes.
- 20** The Golgi apparatus is an assembly point through which raw materials for secretion, such as enzymes, are stored before being removed from the cell. It serves as a collecting and packaging centre of the cell.
- 21** Lysosomes contain digestive enzymes that split complex chemical compounds into simpler ones. A membrane forms around the unwanted structure and lysosomes discharge their contents into this bag. Soluble products are absorbed into the surrounding cytoplasm, to be used as building blocks for new compounds and organelles.

- 22 Similarity: in both endocytosis and exocytosis, vesicles enclose materials to be transported.
Difference: endocytosis is a process that moves substances into a cell and exocytosis is a process that moves substances out of a cell.
- 23 The nucleus.
- 24 The nuclear membrane and the plasma membrane have the same structure.
- 25 DNA is found within the nucleus and RNA is found within the nucleolus. (Note that small amounts of DNA are also found in mitochondria and chloroplasts and that RNA is also present in the cytoplasm).
- 26 The three general types of plastids that are found in cells are chloroplasts, chromoplasts and leucoplasts. Chloroplasts are the site of photosynthesis. Chromoplasts give flowers, fruits and some leaves their special colours. Leucoplasts are used for starch storage.
- 27 Xylem cells have specialised features such as being long and thin. The cells stand end-to-end, forming long continuous tubes, and their side walls are thickened with lignin spirals and rings, making them very strong. This allows water and minerals to travel from the roots to leaves, often a long distance. Phloem sieve cells are long and tubular in shape with sieve-like plates at their ends. They lie end-to-end, allowing sugars in solution to move through them. Companion cells control the functioning of the sieve cells.
By having this type of specialisation, cells allow transport of substances within plants, improving their chances of survival.
- 28 When water is plentiful, vacuoles fill with fluid, exerting pressure on the cell wall and causing the cell to bulge. Like a balloon filling with air, this provides support, allowing the plant to stand up straight. When water is scarce, less fluid is found in the vacuoles, reducing support for the plant and causing it to wilt.
- 29 To meet their requirements for survival or to perform a specific function
- 30 Some cells actively move; others are moved by the medium they are in.
- 31 Cilia perform functions other than moving a cell. They can move substances along a surface. In this instance, cilia line specialised tissue in ducts and tubules.
- 32 Red blood cells do not need to propel themselves as the blood around them is being actively pumped through vessels. This carries the blood cells along the vessel.

Apply understandings

- 1 a To find out if an unknown cell was eukaryotic or prokaryotic, you would need to examine the outer barrier of the cell. If it had a cell wall covered by polysaccharide it would be prokaryotic. If you look at the internal structure of the cell and see membrane-bound organelles, it would be eukaryotic, but if the DNA was not in a membrane-bound nucleus and small rings of DNA were present it would be prokaryotic. If flagella were present and they propelled the cell in a wave-like motion, it would be eukaryotic.

- b** To find out if the unknown cell was from a plant or an animal, you would need to look for the following characteristics that would determine that the cell is from a plant:
- the presence of plastids: chloroplasts, chromoplasts, leucoplasts
 - the presence of large vacuoles
 - a cell wall.

If the cell was from an animal centrioles should be present.

2 i (d), ii (c), iii (f), iv (e), v (a), vi (b)

- 3**
- a** Rough endoplasmic reticulum has ribosomes attached whereas smooth endoplasmic has no attached ribosomes.
- b** The cell wall encloses the plasma membrane in some types of cells. The cell wall, which is made of cellulose, allows water and solutes to move through it easily. The plasma membrane, which is made of lipids and proteins, is semipermeable and regulates the substances moving through it.
- c** Leucoplasts are used for starch storage, chloroplasts are the site of photosynthesis and chromoplasts give flowers, fruits and some leaves their special colours.
- d** Chlorophyll is the green pigment situated within the chloroplast organelle.

4 i (b), ii (d), iii (a), iv (c)

- 5**
- a** A plant cell, because it has a thick cell wall and contains chloroplasts
- b** Electron microscope because of the level of detail.
- c** (i) chloroplast (ii) nucleus
- d** Presence of membrane-bound organelles
- e** A cell is three-dimensional; other organelles may be present in a different area of the cell.

6 So that many different chemical reactions can occur simultaneously in discrete areas of the cytoplasm.

7 These cells would require a lot of instant energy, for example sperm cells. Mitochondria are the cell's energy-producing organelles so the presence of large numbers of them implies a need for lots of energy.

Investigate and inquire

- 1**
- a** Ribosomes, endoplasmic reticulum, Golgi apparatus, plasma membrane
- b** Complex proteins, enzymes, hormones, glycoproteins
- 2**
- a** Cell wall = A; Golgi apparatus = C
- b** Cellulose
- c** The cell wall provides extra support and protection to cells.
- d** Mitochondria = X
- 3**
- a** Eukaryotic
- b** Only bacteria (phylum Monera) and archaea are prokaryotic.
- c** Xylem

- 4**
- a** The solution is kept ice cold to slow down or prevent chemical reactions occurring.
 - b** Sediment: heavier organelles, e.g. nucleus, ER, mitochondria, chloroplasts
Clear fluid: lighter organelles, e.g. ribosomes, lysosomes
 - c** This will depend on individual student research.
- 5**
- Digestive: tongue, oesophagus, stomach, pancreas, liver, small intestine, large intestine
 - Circulatory: heart, blood vessels
 - Nervous: CNS (brain, spinal cord), nerves
 - Excretory: kidneys, skin, lungs
 - Reproductive: female – ovaries, uterus, vagina
male – testes, penis